CHAPTER 7 SEISMIC SAFETY RETROFIT

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EXHIBIT

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CHAPTER 7 SEISMIC SAFETY RETROFIT

7.1 INTRODUCTION

The Seismic Safety Retrofit Program was established by emergency legislation (SB 36X) enacted during an extraordinary legislative session called after the October 17, 1989 Loma Prieta earthquake. The purpose of this program is to evaluate all publicly owned bridges in California and to take actions necessary to prevent their collapse due to earthquakes.

There are approximately 24,000 publicly owned bridges in California: 12,000 on state highways and 12,000 on or over local roadways. The local component of the Seismic Safety Retrofit Program provides funding and other assistance to cities and counties for evaluating bridges and constructing seismic retrofit projects.

The Director of Caltrans has set the mandated Seismic Safety Retrofit Program as a top priority.

7.2 PROGRAM FUNDING

The primary funding source for the local Seismic Safety Retrofit Program is the local share of the federal Highway Bridge Replacement and Rehabilitation (HBRR) funds, with State Highway Account (SHA) funds providing the required match.

Local bridge seismic retrofit projects developed under the mandatory Seismic Safety Retrofit Program (as defined below) are funded fully with a combination of federal and state funds. Eligible work items include consultant selection, seismic analysis leading to strategy selection, environmental, right-of-way, PS&E, construction, construction engineering and inspection. Local agency overhead costs for administering the projects are also eligible for reimbursement. Generally, there should be no cost to the local agency when developing retrofit projects as recommended by the strategy report (see Section 7.9, "Mandatory Strategy Meetings," under "Results," for details), with the exception of up-front progress payments prior to federal and state reimbursement.

There may be cases when a local agency chooses to expand the scope of a retrofit project to include other work such as rehabilitation, widening or bridge replacement. The local agency will be responsible for all costs in excess of the retrofit estimate, or the required local match for excess costs if the additional work qualifies for other federal funding (see Section 7.4, "Eligible Costs," of this chapter for details).

7.3 PROJECT ELIGIBILITY

This mandated Seismic Safety Retrofit Program is limited to those bridges that are determined to be Category 1, which is defined as bridges that might collapse in a seismic event.

SEISMIC SCREENING OF BRIDGES

At the outset of the local Seismic Safety Retrofit Program, all 12,000 local bridges were considered candidates for retrofitting. Caltrans has since performed a series of three technical screenings on these local bridges to determine if further seismic analysis would be needed. The screening processes utilized a seismic risk-ranking algorithm to assign a Ranking Factor to each of the bridges. Factors considered in these screenings included items such as traffic, bridge as-built information, and the nature of nearby faults. Bridges with Ranking Factors above a certain threshold were considered seismically vulnerable and were selected for inclusion in this mandatory program for further seismic analysis and potential retrofit.

RESULTS OF SEISMIC SCREENING

As of January 1, 2001 these screenings resulted in the following seismic safety findings:

BRIDGES	
10,165	Seismically safe: these bridges require no further analysis or retrofit.
631	Some seismic risk: these bridges have particular vulnerable details that warrant further examination when doing other work to the bridges.
1,204	Seismically vulnerable: these bridges require mandatory seismic analysis and retrofit if required by the analysis. Listing and current status of these bridges are available from the Seismic Safety Retrofit Program under "Program Information" of the Local Assistance website: www.dot.ca.gov/hq/LocalPrograms/

PROGRAMMING NEW PROJECTS

When a local agency has new information about a bridge that has not been retrofitted under this program, e.g., new seismic faults or soil conditions, that may change the Ranking Factor of the bridge or seismic analysis calculations, the local agency may request a new screening analysis of the bridge by Caltrans. If this new analysis results in a ranking above the level considered seismically vulnerable, the bridge will be added to the mandatory program. Local agencies should contact their Caltrans District Local Assistance Engineer (DLAE) for assistance.

Additional restrictions and deadlines on availability of matching funds from the State Highway Account on the mandatory retrofit projects may be imposed in the future as conditions change.

7.4 ELIGIBLE COSTS

All local agency costs which are directly attributable and/or properly allocatable to the specific Seismic Safety Retrofit project established by the strategy meeting (see Section 7.9), are eligible for reimbursement.

Appropriate PE costs, including Strategy, PS&E development and Consultant Oversight, are reimbursable according to Chapter 6, "HBRR Program," of this manual, Section 6.4.3, "Preliminary Engineering (PE) Costs."

To be reimbursed, local agencies are to follow the standard procedures outlined in the *Local Assistance Procedures Manual* (LAPM).

PROJECTS WITH DIFFERENT SCOPE

A local agency may decide to develop a construction project that is more extensive than that approved at the strategy meeting. For example, a local agency may choose to replace a bridge when the strategy meeting recommended retrofit. Agencies may also expand the retrofit project to design a higher performance standard than no-collapse, or to include bridge rehabilitation to address general bridge deficiencies. When these situations occur, the local agency is responsible for the extra cost beyond the program's committed funding towards the no-collapse retrofit project as recommended by the strategy. The program's funding commitment is the cost estimate included in the final strategy (approval) document. This funding commitment may be increased if additional cost items needed to complete the recommended project are identified by the local agency. Caltrans DLAEs, along with Headquarters Area Engineers and Seismic Retrofit Program Manager, will review these additional costs. Appropriate costs will be allowed and added to the total project cost.

If a bridge is on the HBRR eligible bridge list and the extra work qualifies for HBRR program funding, the extra cost may be partially (80%) covered by HBRR funds with local funding providing the match (20%).

7.5 ROLES AND RESPONSIBILITIES

DESIGNATION OF LEAD AGENCIES

The following three lead agencies were designated in accordance with the provisions of Section 179.3 of the Streets and Highways Code.

LOS ANGELES COUNTY was designated lead agency for local bridge retrofit projects in all the cities in Los Angeles County.

SANTA CLARA COUNTY was designated lead agency for local bridge retrofit projects located within the unincorporated portion of the county.

CALTRANS was designated lead agency for the remainder of local seismic retrofit projects throughout the state.

Total local Seismic Safety Retrofit Program = 1,204 Bridges (as of January 1, 2001).

Los Angeles County lead agency:	286 bridges
Santa Clara County lead agency:	36 bridges
Caltrans lead agency:	882 bridges

ROLES OF LEAD AGENCIES

The first responsibility of the lead agency was to inspect all publicly owned bridges within its jurisdiction to assess the need for analysis and potential retrofit work. This was completed in all areas through the seismic screenings performed by Caltrans.

The lead agency is responsible for making sure that a retrofit project is developed for each bridge that has been determined to require mandatory seismic analysis.

In addition to the above general lead agency responsibilities cited, Los Angeles County and Santa Clara County also took on the responsibility of actually developing seismic retrofit projects for bridges that fall under their jurisdiction.

ROLES OF LOCAL AGENCIES

For bridges where Caltrans was the designated lead agency, Caltrans offered to assist local agencies in performing seismic analysis and retrofit design. Most local agencies accepted this offer and Caltrans contracted out this work to consultants. These consultants have since completed all requested seismic analyses and structural retrofit design. All completed structure PS&Es have been delivered to local agencies. For these bridges, the responsibility of the bridge owning agency is to incorporate the retrofit design with environmental and other non-structural components of the project, to advertise and administer the construction contracts.

Those local agencies that are performing their own seismic analysis and design are responsible for developing seismic retrofit projects from start to finish. This includes, but is not limited to, initiating the projects, performing (or overseeing consultant performance of) seismic analyses, presenting the retrofit strategy to Caltrans at mandatory strategy meetings, ensuring environmental compliance, preparing PS&E, advertising and administering the construction contracts.

PROGRAMMING OF SEISMIC PROJECTS

All seismic retrofit projects must be included in the currently approved Federal Statewide Transportation Improvement Program (FSTIP) as an individual project or as part of a lump sum listing before federal funds can be authorized.

To expedite project delivery, Caltrans has instructed each Metropolitan Planning Organization (MPO) to include a blanket amount in their FTIPs for seismic and HBRR programs. In non-MPO areas, Caltrans has programmed these blanket amounts.

7.6 DESIGN STANDARDS

BASIC NO-COLLAPSE STANDARDS

The primary philosophy for the Seismic Safety Retrofit Program is to prevent bridge collapse. The result of a retrofit project should be a bridge that is safe from collapse in the event of a maximum credible earthquake. It is possible that the designer may demonstrate by analysis that a bridge will not collapse without any retrofit. In this case a "do nothing" strategy is an acceptable assessment. The designer must be cautioned to follow all load path demands and assure that no one portion of the resisting structural frame is deficient. "Bridge replacement" may also be an acceptable strategy when the existing bridge is in poor structural condition and the cost of retrofitting the bridge approaches or exceeds the cost of a new bridge with similar geometric configuration.

In addition to design standards and references in the LAPM Chapter 11, "Design Standards," the following design standards and references are available to those involved in seismic design:

1. Caltrans Bridge Manuals:
   Bridge Design Manual –modified AASHTO specifications
   Bridge Memo to Designers
   Bridge Design Details
   Bridge Design Aids
   Bridge Memo To Designers 20-4, October 1995 – Earthquake Retrofit Guidelines for Bridges

2. *Seismic Design Criteria, Version 1.1* – Available from Caltrans, Division of Structures.

3. Other Related Publications: Various publications of design notes and research results from the University of California at Berkeley, San Diego and others. These publications are used extensively in current practice and enable the industry to keep up with the very latest research results. These research projects are listed in the *Bridge Memo To Designers 20-4.*

4. Computer Programs: Various computer programs have been developed by Caltrans' engineers. These programs will help ease the analysis and calculations required in retrofit analysis. They are available to consultants and local agencies involved in retrofit design.

Programs:	Beams304	Col604n	Col702r	Frame407
	Nfoot	Wframe	Xsection	

5. Caltrans Standard Special Provisions: The Division of Structures has Standard Special Provisions available on the Internet located in the Caltrans Engineering Service Center homepage at: www.dot.ca.gov/hq/esc/structurespecs/BRIDGE/.

References mentioned above are available through the Caltrans Structures Local Assistance Office.

HIGHER LEVEL PERFORMANCE RETROFIT STANDARDS

Some local agencies have expressed desire to retrofit their bridges to a service level performance standard. They would like to retrofit their bridges not only to withstand earthquakes but to suffer only minor damages that could be quickly repaired and allowing quick resumption of service. This would typically require extra or different retrofit measures that cost more than the standard no-collapse retrofit. Requests like this will be treated the same way as those projects with expanded scopes. The local agency will be responsible for any cost above and beyond that of the standard no-collapse retrofit.

METRIC

Either English or metric units may be used when the local agency, or their consultant, prepares the final PS&E package for bridge retrofit projects. However, English units must be used when Caltrans' consultants prepare the final PS&E package for seismic retrofit design. Regardless of the units used, both the bridge and roadway units must be the same (see Chapter 12, "Plans, Specifications and Estimate," of the LAPM for more information).

7.7 CONSULTANT SELECTION

Local agencies may retain the services of consultants to do all or part of the seismic design. Local agencies shall follow the consultant selection procedures in Chapter 10, "Consultant Selection," of the LAPM.

It is recommended that 10% of the funds authorized for preliminary engineering be retained for the design support during construction phase and the consultant contract be written so that the consultant will be able to answer questions about the design during construction and to assist on change orders.

7.8 MANDATORY FIELD REVIEWS

OBJECTIVES

Field reviews for seismic retrofit projects are mandatory. The objectives of field reviews for seismic retrofit projects are also different in several ways from typical local agency projects as outlined in Chapter 7, "Field Review," of the LAPM. The objectives of a seismic project field review are to:

- Begin to scope the project. (The project will not be fully scoped until after the strategy meeting.)
- Verify that the As-Built plans accurately represent the existing conditions.
- Check for modifications that would affect the seismic response of the structure.
- Dimension any members that are not accurately shown on the As-Built plans.
- If no As-Built plans are available, measure and dimension all pertinent structural members.
- Check for new conditions that would be affected by construction work.
- Discuss environmental considerations.

Important items to keep in mind for retrofit project field reviews include:

Access	Clearance	Coordination	Detour
Environmental	Falsework	Obstructions	Utilities
Modifications	Hydraulics	Permits	

WHO SHOULD ATTEND

Field reviews should be attended by:

- Consultants (if any)
- Local agency staff knowledgeable of utilities, right-of-way, environmental, traffic, etc.
- Caltrans Structures Local Assistance staff (if time and resources permit)
- Caltrans District Local Assistance staff (if time and resources permit)
- Caltrans District Environmental staff (if time and resources permit)

RESULTS

- The scope of the project is determined.
- The existing conditions are verified and any modifications documented.
- Construction controls are determined.
- Responsibilities are reviewed.

7.9 MANDATORY STRATEGY MEETINGS

OBJECTIVES

The objectives of the strategy meetings are to:

- Offer seismic designers support or alternative approaches.
- Determine that standard seismic retrofit details are being fully utilized.
- Establish alternative acceptable procedures to satisfy retrofits when unusual problems are encountered.
- Recommend alternative analysis when appropriate.
- Inform the project engineer of solutions to similar problems encountered by Caltrans, consultants, or other local agencies.
- Provide local agency personnel with information regarding potential traffic control, right-of-way, utility, and environmental problems.
- Achieve consensus agreement on economical and practical retrofit strategies.

WHO SHOULD ATTEND

The strategy meeting should be attended by:

- Design Consultants (Structural, Geotechnical, and Traffic if necessary)
- Local agency staff
- Caltrans Structures staff from:
  - Earthquake Engineering
  - Structures Design
  - Structures Construction
  - Structures Maintenance
  - Structural Foundations
- Structures Local Assistance Representative
- District Local Assistance Engineer

PREPARATION FOR THE MEETING

The designer or project engineer is expected to have performed the diagnostic analysis using the appropriate static and dynamic analysis, summarized the condition of columns, restrainers/hinges and abutments, and prepared a proposed solution prior to scheduling a strategy meeting. The designers should be prepared to discuss solutions considered and reasons for rejection of alternatives. At a minimum, a General Plan employing a legend of retrofit work and location of work, along with a table outlining the controlling design ductility ratios, should be presented. Additional tables and proposed details may also be necessary.

The local agency should be prepared to discuss the history of the bridge, environmental concerns, and any restrictions to construction such as traffic, right-of-way, etc.

MATERIALS REQUIRED FOR THE MEETING

The following materials are required for the Mandatory Strategy Meeting:

- Draft Strategy Report, including the General Plan, Sufficiency Rating from the Eligible Bridge List (see Chapter 6, "HBRR Program," of this manual), as-built plans, photographs, and an estimate of costs (capital and engineering). These materials (a minimum of 10 copies) should be submitted to the DLAE. The DLAE should forward the package to Structures Local Assistance Office in Sacramento two weeks prior to the scheduled strategy meeting.

- Any plans or reports pertinent to the proposed work (utility layout, right-of-way maps, etc.)

RESULTS

A general consensus regarding the acceptable analysis and retrofit approach should be reached by the strategy meeting attendees. Additional strategy meetings should not be necessary if all the information noted above is provided prior to and during the meeting. The conclusions reached should be outlined and summarized by the agency responsible for seismic design in "strategy meeting minutes" and documented in the Final Strategy Report. A copy of the minutes should be sent to all attendees. A copy of the Final Strategy Report will be kept on file in the Structures Local Assistance Office.

7.10 PROCESSING PROCEDURES WHEN CALTRANS IS THE LEAD AGENCY

Comprehensive processing procedures for developing local bridge retrofit projects under the Seismic Safety Retrofit Program are shown in Exhibit 7-A, "Seismic Safety Retrofit Program Flowchart" of this chapter. The following discussion is a summary of the procedural steps involved.

Blocks of projects are identified for each local agency for development based upon available funds and preliminary cost estimates. Project development activities vary somewhat depending upon which agency is responsible for seismic design. In general, structures are analyzed in priority order according to the rankings established by Caltrans' screening.

CALTRANS RESPONSIBLE FOR SEISMIC DESIGN

As of July 2001, Caltrans completed seismic analysis and structure design of all Seismic Safety Retrofit Program bridges for which it is responsible. Local agencies that requested Caltrans assistance should either have received or be expecting to receive the structure portion of the PS&E from Caltrans. Therefore, most agencies should be able to proceed directly to Step 12 of the following procedure, unless they have not requested authorization for preliminary engineering or not completed the necessary environmental documents:

1. Caltrans issues consultant task orders.
2. The local agency submits a "Request for Authorization" for the preliminary engineering phase (see Chapter 3, "Project Authorization" of the LAPM).
3. Caltrans issues an "Authorization to Proceed" to the local agency (see Chapter 3, "Project Authorization," of the LAPM).
4. Caltrans initiates the mandatory Field Review (see Section 7.8, "Mandatory Field Review" of this chapter).
   - The local agency that owns the bridge is required to attend.
   - Caltrans will give a minimum 2-week notification.
   - The local agency begins work on the Field Review form and Preliminary Environmental Study (PES) (see Chapter 6, "Environmental Procedures," of the LAPM).
5. Caltrans completes initial structural analysis after the Field Review.
6. The local agency finishes preliminary environmental investigations according to LAPM Chapter 6, "Environmental Procedures."
7. Caltrans holds a mandatory Strategy Meeting that determines which actions to take on the bridge.
8. The local agency completes a Field Review form after the Strategy Meeting.
9. The Division of Local Assistance (DLA) submits a Program Supplement for preliminary engineering to the local agency for execution.
10. The local agency completes environmental documents per previous discussions and meetings.
11. Caltrans completes the structural portion of PS&E and transmits it to the local agency.
12. The local agency completes the roadway portion of PS&E and combines it with the Caltrans PS&E portion. Caltrans will not review the combined PS&E. The local agency will certify the non-structural portion of the PS&E (see Chapter 12, "PS&E," of the LAPM).
13. The local agency submits a "Request for Authorization" for construction and constructs the project (see Chapter 3, "Project Authorization," of the LAPM).
    - "Authorization to Proceed" is required before the project is advertised.
    - DLA submits the Program Supplement for construction to the local agency for execution.
    - The Program Supplement must be executed before a local agency can be reimbursed (see Chapter 4, "Agreements," of the LAPM).
    - Caltrans will not provide oversight of the construction project; Caltrans will verify project completion.

LOCAL AGENCY RESPONSIBLE FOR SEISMIC DESIGN

Procedures are the same as when Caltrans is responsible for seismic design, except that:

1. The local agency submits a blanket "Request for Authorization" for preliminary engineering (see Chapter 3, "Project Authorization," of the LAPM).
   - Combines all bridges that the local agency will be responsible for into one "Request for Authorization."
   - Caltrans will verify that the project/funding is programmed in the FSTIP and the FSTIP has been approved by the FHWA.
2. Caltrans issues a blanket "Authorization to Proceed" and submits a Program Supplement for preliminary engineering to the local agency for execution.
3. If the local agency chooses to utilize consultants, see Section 7.7, "Consultant Selection" of this chapter.
4. The local agency initiates the mandatory Field Review.

- Sends out notification of the Field Review 2-weeks prior with a complete listing of bridges to be reviewed to all appropriate people (see Section 7.8, "Mandatory Field Review," of this chapter).
- Caltrans District and Structures staff will attend if staff time allows.

5. The local agency completes the initial structural analysis and begins other preliminary studies (see Chapter 6, "Environmental Procedures," of the LAPM).
6. The local agency schedules a mandatory Strategy Meeting with Caltrans Structures.
   - The local agency will give a 2-week notification.
   - All meetings will be held in Sacramento.
   - All local agency travel costs are reimbursable.
   - See Section 7.9, "Mandatory Strategy Meeting," of this chapter.
7. The local agency completes the structures and roadway PS&E.
   - Caltrans Division of Structures will review 90% and 100% PS&E for concurrence with the strategy document.
   - The local agency certifies the completed PS&E package (see Chapter 12, "PS&E," of the LAPM).
8. The local agency submits a "Request for Authorization" for construction and constructs the project (see Chapter 3, "Project Authorization," of the LAPM).
   - "Authorization to Proceed" is required before the project is advertised.
   - DLA submits the Program Supplement for construction to the local agency for execution.
   - The Program Supplement must be executed before a local agency can be reimbursed (see Chapter 4, "Agreements," of the LAPM).
   - Caltrans will not provide oversight of the construction project; Caltrans will verify project completion.

7.11 COORDINATION OF SEISMIC AND HBRR PROJECTS

A number of seismic retrofit candidate bridges are also candidates for the HBRR Program (a program regarding the replacement or rehabilitation of bridges). For these bridges, a combination of seismic and HBRR funds may be used.

On bridges for which local agencies are responsible, the local agency should carefully review the eligible bridge list before beginning any seismic analysis of the bridge. In some cases, replacement or rehabilitation incorporating seismic considerations may be the best alternative.

On combined HBRR and seismic projects, the local agency should take the project to the strategy meeting to establish estimated capital costs for the seismic project. For capital cost of the combined project (right of way and construction), the state will provide the matching funds up to the estimated seismic retrofit cost established at the strategy meeting and the local agency will provide the matching funds to the cost in excess of the seismic cost. For support costs (preliminary engineering and construction engineering), the state and the local agency will be required to provide their proportional shares of the matching funds based on their estimated capital expenditure (established at strategy meeting).

7.12 REFERENCES

Most references are available either from the Division of Local Assistance website (www.dot.ca.gov/hq/LocalPrograms/) or the Division of Structures website (www.dot.ca.gov/hq/esc/).

Local Assistance Program Guidelines
Local Assistance Procedures Manual
Streets and Highways Code, Section 179.3
Bridge Design Manual –modified AASHTO specifications
Bridge Memo to Designers
Bridge Design Details
Bridge Design Aids
Bridge Memo to Designers 20-4, October 1995 – Earthquake Retrofit Guidelines for Bridges
Seismic Design Criteria, Version 1.1

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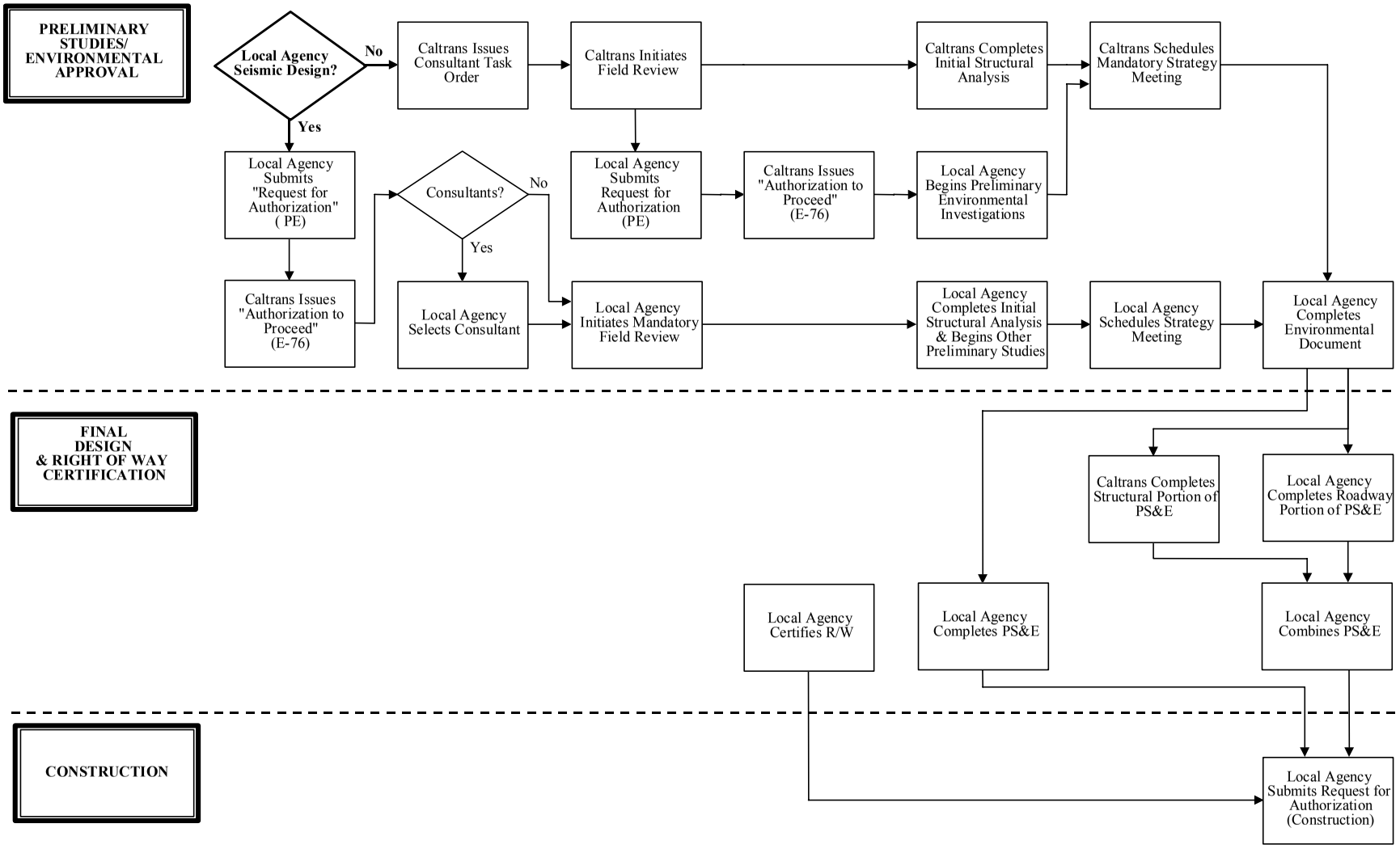
PRELIMINARY STUDIES/ ENVIRONMENTAL APPROVAL
Local Agency Seismic Design?
No
Yes
Caltrans Issues Consultant Task Order
Caltrans Initiates Field Review
Caltrans Completes Initial Structural Analysis
Caltrans Schedules Mandatory Strategy Meeting
Local Agency Submits "Request for Authorization" (PE)
Consultants?
No
Yes
Local Agency Submits Request for Authorization (PE)
Caltrans Issues "Authorization to Proceed" (E-76)
Local Agency Begins Preliminary Environmental Investigations
Caltrans Issues "Authorization to Proceed" (E-76)
Local Agency Selects Consultant
Local Agency Initiates Mandatory Field Review
Local Agency Completes Initial Structural Analysis & Begins Other Preliminary Studies
Local Agency Schedules Strategy Meeting
Local Agency Completes Environmental Document
FINAL DESIGN & RIGHT OF WAY CERTIFICATION
Caltrans Completes Structural Portion of PS&E
Local Agency Completes Roadway Portion of PS&E
Local Agency Certifies R/W
Local Agency Completes PS&E
Local Agency Combines PS&E
CONSTRUCTION
Local Agency Submits Request for Authorization (Construction)

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